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(54) Sealing strips and methods of making them.

(57) For producing a bend or corner in a sealing strip 16, to match the shape of a bend or corner in its mounting flange, a portion of the sealing part 26 is removed between parts 26A and 26B, so as to produce a correspondingly shaped cut-out. The sealing strip is then placed within a mould cavity 54 which is curved to match the required configuration for the bend or corner and has an internal surface matching the external surface of the sealing part 26. A metal core 60, having a cross-sectional size matching that of the hollow interior of the sealing part 26, is placed in position within the cut-out by a swinging arm 58. Moulding then takes place whereafter arm 58 is swung outwards so as to withdraw core 60 (portion 26B has to be partially flattened to facilitate this). A small part D of the cut-out, which is blocked by, arm 58 during the moulding process, is left open. This is then closed off by a further injection moulding operation using a short core matching the cross-sectional shape of the core 60. This short core has a narrowed neck by means of which it can be pulled out of the sealing part 26B through a small hole in the sealing part which is thereafter closed by a grommet.

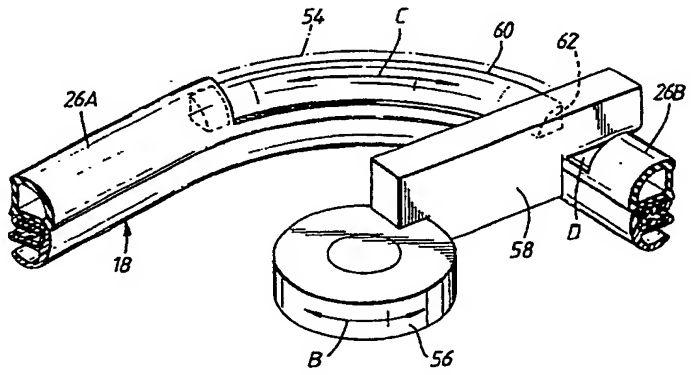

Fig.6.

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SEALING STRIPS AND METHODS AND APPARATUS FOR MAKING THEM

The invention relates to sealing strips and methods and apparatus for making them.

Sealing strips are known for use in the sealing of door and other openings in motor vehicle bodies. The perpiphery of such an opening may be defined by a flange which lies generally in the plane of the opening and is formed by a joint where inner and outer body panels are brought together and welded. Such known sealing strips comprise a channel-shaped gripping section which is sized to embrace and firmly grip the flange and has attached to it a soft sealing part which runs along the length of one outside wall of the channel of the gripping part and is thus supported thereby so as to run around the periphery of the opening. The door or other closure member closes onto the soft sealing part, partially compressing it, and thereby providing an effective weather seal.

Such sealing parts are often hollow and tubular. It is also known to connect the hollow interior of such a sealing part to a pressure or vacuum pump so that the air pressure within the hollow tubular part can be increased and decreased. When the air pressure is decreased, the door or other closure member can be closed easily, and the pressure can thereafter be increased so as to provide the effective sealing which is required. Clearly, such an arrangement is only practicable if the hollow tubular sealing part is air-tight along its whole length including over regions where it is necessary to carry out special manufacturing techniques to form corners or bends in the sealing strip.

According to the invention, there is provided a method of forming a bend or corner in a longitudinally extending sealing strip having a hollow sealing part of predetermined cross-sectional shape, comprising the steps of removing material of the sealing part in the region of the sealing strip where the bend or corner is to be formed so as to form a cut-out between first and second spaced ends of the sealing part, placing the sealing strip in a mould such that the mould cavity covers the major portion of the cut-out but leaves uncovered a minor portion of the cut-out adjacent the said second end, the mould cavity having an internal shape matching the external shape of the major part of the removed part but curved to match the bend or corner, placing within the mould cavity a core curved to match the bend or corner, injecting material into the mould cavity between it and the core so as to reform the removed portion of the sealing part over the said major portion of the cut-out but with the required bend or corner configuration, removing the core via the gap formed by the minor portion of the cut-out part, and then closing off the said gap.

According to the invention, there is further provided apparatus for producing a bend of predetermined configuration in the hollow sealing part of a longitudinally extending sealing strip, comprising a mould having a mould cavity shaped and sized to receive the sealing strip in a region where the sealing part has been removed so as to form a cut-out between first and second spaced ends of the sealing part, the mould cavity having an internal shape matching the external shape of the removed sealing part along a major part of the length of the cut-out but not including a minor part thereof adjacent the said second end and the cavity being curved to match the curvature of the bend or corner, a curved core matching the curvature of the bend or corner, means for inserting the core into the cavity when the sealing part is positioned with the major part of the cut-out therein, and means for removing the core from the cavity after a moulding operation therein, the core being removed via the gap in the sealing part formed by the minor portion and which remains after the moulding operation.

Sealing strips for sealing around door openings on motor vehicle bodies and embodying the invention, and methods and apparatus according to the invention for making such sealing strips, will now be described, by way of example only, with reference to the accompanying drawings in which:-

Figure 1 is a side view of the motor vehicle body;

Figure 2 is a section on the line II-II of Figure 1;

Figure 3 is a section on the line III-III of Figure 1;

Figure 4 is a perspective scrap view of part of the flange in the region of section III-III;

Figure 5 is a perspective view of part of the sealing strip at a stage in its manufacture;

Figure 6 is a diagrammatic view of part of the apparatus for use in manufacturing the sealing strip;

Figure 7 shows the apparatus of Figure 6 at a later stage in the manufacturing process;

Figure 8 is a perspective view showing more detail of the apparatus of Figures 6 and 7;

Figure 9 is a perspective view showing a following stage in the manufacturing process;

Figure 10 is a perspective view of a core used in the manufacturing stage illustrated by Figure 9;

Figure 11 is a cross-section on the line IX-IX of Figure 9 and showing a grommet in position;

Figure 12 illustrates apparatus for fitting the grommet of Figure 11;

Figure 13 shows the apparatus of Figure 12 in operation; and

Figure 14 is a view corresponding to Figure 11 but showing a modified form of grommet.

Figure 1 shows a motor vehicle body 10 having a door opening 12 which is defined by a flange 14 running completely around the opening. The door for the opening 12 is not shown. In order to provide a weather-proof seal around the periphery of the door opening, a sealing strip 16 is mounted on the flange 14 as shown in Figure 2. The sealing strip 16 comprises a gripping part 15 which is channel-shaped in cross-section and is made of plastics or rubber material 20 which is extruded over a channel-shaped metal core or carrier 22. The metal carrier 22 may take any suitable form. For example, it may comprise a series of side-by-side U-shaped metal members which define the channel and are either connected together by short flexible integral connecting links or are entirely disconnected. Instead, the carrier may be made of looped wire. Other forms of carrier are possible. Advantageously, a flexible but substantially inextensible tape (not shown) may be embedded in the extruded material 20 so as to extend along the length of the strip and prevent stretching.

The extruded material 20 is advantageously extruded to provide integral gripping lips 23. These are directed towards the base of the channel and, when the sealing strip is placed in position on the flange 14, make frictional contact with the sides of the flange 14 and ensure that the gripping part is firmly held in position.

The lips 23 need not be of the same hardness as the remainder of the extruded material 20.

In addition, the sealing strip 16 includes a sealing part 26. This is made of extruded rubber and is generally tubular in shape and hollow. As shown in Figure 2, it is secured to the outside of one side wall of the channel of the gripping part 18, such as by adhesive. Such construction is particularly used where the extruded material 20 is plastics. However, if the extruded material 20 is rubber, then the rubber sealing part 26 can be extruded integrally with the rubber 20. Advantageously, the rubber of the sealing part 26 is foamed or cellular so as to increase its flexibility.

In use, the sealing strip 16 is so supported that the door for closing the opening closes onto the sealing part 26 and partially compresses it, thus providing an effective weather-proof seal around the entire periphery of the door.

On the opposite outside channel wall, an enlarged lip 28 is provided which is again integral with the extruded material 20. The purpose of the lip 28 is primarily to locate and hide the edge of the interior trimming fabric of the vehicle body which is tucked up within the opening 30.

In use, the sealing strip extends around the entire periphery of the door.

In order to improve the functioning of the sealing strip, the hollow tubular sealing part 26 is made to be air-tight and a pump is provided in known manner for increasing and decreasing the air pressure within the sealing part. Such pressure changing enables the air pressure to be lowered when the door is to be closed onto the opening. The reduction in air pressure partially collapses the sealing part 26 and facilitates closing of the door. Thereafter, the air pressure within the sealing part 26 is increased, so as to inflate it and provide effective sealing. Figure 3 shows how the pressure within the sealing part 26 can be increased and decreased.

As shown, a generally tubular metal plug 34 having a through-bore 36 is forced through holes formed in the side walls of the channel of the gripping part 18, and through the metal carrier 22. The outside of this plug 34 is screw-threaded and engages a generally square nut 38. This nut seats itself in a square-section slot 40 (Figure 4) which is cut in the flange 14 at the appropriate place. One end 42 of the plug 34 opens into the hollow interior of the sealing section 26 while the other end 44 is concealed behind the lip 28 which enables a suitable connection to be made to the pump (not shown).

Such an arrangement clearly requires that the hollow tubular sealing part 26 be properly air-tight around the entire periphery. The sealing strip will be manufactured in indefinite length and an appropriate length will then be cut off and its two ends joined together to form a complete ring of the appropriate peripheral length. However, it is not possible for such a length of sealing strip to be properly fitted onto the entire flange. As shown at region A in Figure 1, the door opening contains at least one relatively sharp corner and the sealing strip cannot be bent sharply enough to match this corner. It is therefore necessary to carry out a particular forming process so as to match the configuration of the sealing strip to this corner and this process will now be described. Clearly, it is important that the process does not impair the air-tightness of the complete sealing part.

In order to provide an appropriately shaped bend or corner in the sealing strip to match the corner in the flange as shown at region A in Figure 1, a length of the sealing part 26 is removed (between 26A and 26B) as shown at 50 in Figure 5. The sealing part is completely removed except for vestigial parts of its walls shown at 50A and 50B. Also shown in Figure 5 is the join 52 between the two ends of the length of sealing strip. The region of the sealing strip incorporating the cut-out 50 is then subjected to an injection-moulding operation now to be described.

This moulding operation uses a mould having a

cavity which has such internal shape and configuration that, when the sealing strip with the cut-out 50 is placed in position within the cavity and rubber material thereafter injected, the result is to re-form the section of the sealing part which was removed to form the cut-out 50 -except that the cavity is formed with such curvature that the injection-moulded section of the sealing part has the required curvature to match the bend at region A (Figure 1).

As shown in Figure 6, the mould, whose body is not illustrated, defines a curved cavity 54 matching the external shape of the sealing part 26 and curved to match the bend of region A. In addition, the mould incorporates a rotary member 56 carrying a radial arm 58. Mounted on the radial arm 58 is a solid curved core 60, such as made of metal. The curvature of the core 60 matches that of the bend of region A and its cross-sectional shape matches the interior cross-sectional shape of the sealing part 26. As the rotary member 56 rotates in the directions of the arrows B, the core moves in the directions of the arrows C.

Prior to the moulding operation, the rotary member 56 positions the arm 58, and the core 60, in the attitude shown in Figure 6. In other words, the core 60 extends along the length of the cut-out 50 which is located within the mould cavity 54. In fact, the arm 58 spaces the end 62 of the core 60 from the end of the cut-out 50 defined by sealing part 26B; in other wordsl there is a region D of the cut-out 50 over which the core 60 does not extend.

The opposite end of the core 60 extends partly into the sealing part 26A at that end of the cut-out 50.

The actual injection moulding operation then takes place. That is, rubber material is injected into the cavity 54 so as to fill the space between the core 60 and the cavity 54.

The result is the formation, by the injection moulding process, of a curved sealing part 26A (see Fig. 7) which matches in external cross-sectional shape the external cross-sectional shape of the adjacent portions 26A and 26B. In addition, its internal cross-sectional shape matches the internal cross-sectional shape of the adjacent portions. It is of course formed with appropriate curvature to match the curvature required for the bend at region A (Fig. 1).

As shown in Figure 7, which omits the part of the mould defining the cavity 54, rotary member 56 is then rotated so as to swing the arm 58 into the position shown. This draws the curved core 60 out of the interior of the moulded-on portion 26C of the sealing part 26. This withdrawal process necessitates flattening of the portion of the sealing part 26B adjacent the cut-out D, but the flexibility of the material of the sealing part here renders this quite easy. Fig. 7 also shows that the join line 52 (Fig. 5) between the two ends of the sealing strip are situated within cut-out D.

Figure 8 shows the actual mould 63 in more detail. As shown, it comprises a block incorporating the cavity 54 in which the part of the sealing strip incorporating the cut-out 50 is inserted. The rotary member 56 and the arm 58 are mounted externally on the block 63, the arm being shown in its two positions.

It is now necessary to complete the sealing strip by closing-up the remaining cut-out D. As shown in Figure 9, this is carried out in a second injection-moulding operation using a further metal core 66. Figure 9 shows this core in position and Figure 10 shows it before insertion. It is generally bottle-shaped and has an underside 68 which is flat except for a groove 70. The core 66 is positioned within the sealing parts 26C and 26B (Figure 9) so that the groove 70 bridges over the join line 52 (see Fig.5).

The sealing strip with the core 66 in position is then placed in a further mould cavity (not shown) whose internal shape and configuration match the external shape and configuration of the sealing part 26. Rubber material is then injected and completes the sealing part, that is, it encloses the cut-out D and in a manner which matches the curvature at region A.

It is then necessary to remove the core 66. The core is removed by manipulating the soft material of the sealing part 18 so as to push a narrow neck 72 of the core through a hole 74 in the base 76 of the gripping part 18. By pulling on the neck 72, the entire metal core can be pulled through the opening 74, the flexibility and stretchability of the material of the sealing part enabling this to be done.

The groove 70 (Figure 10) ensures that some of the injected material is placed directly over the join line 52 so as to prevent any possibility of air leakage here.

After the moulding operations described, the sealing strip is subjected to vulcanisation as by hot air oven.

All that remains in order to complete the bend is to close off the hole 78. The hole is closed by means of a rubber grommet 80 as shown in Figure 11. Rubber grommet 80 is fixed in position using a tool 82 as shown in Figure 12. The tool comprises a hollow metal cylinder 84 whose diameter is greater than the diameter of the hole 78. A piston 86 is slidable within the cylinder 84 and carries a nose 88 on which is mounted the grommet 80. In order to fix the grommet in position, the whole tool is bodily moved into contact with the sealing part 26 and piston 86 is then slid relative to the cylinder 84, such as by manual or air or hydraulic pressure for example, so as to push the grommet 80 par-

tially through the hole 78 and into the locking configuration shown in Figure 11. Then, while the cylinder 84 is held pressed against the sealing part surrounding the opening 78, the piston 86 is withdrawn so that the neck 88 separates from the grommet 80 which remains in the proper position within the hole 78, all as shown in Figure 12. Figures 11 and 12 omit the gripping part 18 of the sealing strip.

The inserted grommet 80 is smeared with suitable mastic before fitment and the strip is thereafter subjected to vulcanisation as by hot air oven to cure this mastic.

Figure 14 corresponds to Figure 11 but shows a modified form of the grommet 80 which incorporates an air inlet/outlet 90 by means of which the pressure within the hollow interior of the sealing part can be altered in use of the seal. The modified form of grommet can be fitted in substantially the manner illustrated in Figures 12 and 13.

The foregoing description of the moulding and subsequent operations assume that the sealing part 26 is extruded separately from the gripping part 18. In such a construction, the extruded material 20 (Figure 2) of the gripping part 18 is normally plastics (e.g. PVC) (the sealing part is rubber). During the moulding operations it is preferable to protect the plastics from the heat of the moulding.

If the sealing strip is such that the sealing and gripping parts are extruded together in rubber, the cutting operation, to form the cut-out 50 (Figure 5), is advantageously modified so as to cut away extra rubber, this extra rubber being rubber on the adjacent side of the gripping part 18 and being cut away to leave exposed the adjacent part of the metal carrier 22. During the moulding operation, this cut-away extra rubber is replaced by the moulding process but the replaced rubber differs from the original cut-away extra rubber in that it is curved to match the curvature of the bend of region A (Figure 1) and is therefore less stressed than would the original extra rubber if it were not cut-away but curved to match the bend.

Claims

1. A method of forming a bend or corner in a longitudinally extending sealing strip (16) having a hollow sealing part (26) of predetermined cross-sectional shape, comprising the steps of removing material of the sealing part (26) in the region of the sealing strip (16) where the bend or corner is to be formed so as to form a cut-out (50) between first and second spaced ends of the sealing part (26), placing the sealing strip (16) in a mould (63) with the cut-out (50) extending into the mould cavity (54) thereof, the mould cavity (54) having an internal shape matching the external shape of the material removed from the cut-out (50) in the mould cavity (54), placing within the mould cavity (54) a core (60), and injecting material into the mould cavity (54) between it and the core (60) so as to produce moulded material replacing at least part of the removed material of the sealing part (26), characterised in that the mould cavity (54) is curved to match the bend or corner and the core is similarly curved, and in that the mould cavity (54) covers the major portion of the cut-out (50) but leaves uncovered a minor portion (D) of the cut-out (50) adjacent the said second end, and by the steps of removing the core (60) via the gap (D) formed by the minor portion of the cut-out part (50), and then closing off the said gap (D).

2. A method according to claim 1, characterised in that the step of removing the core (60) through the said gap (D) includes the step of partially flattening the material of the sealing part (26) adjacent the said second end.

3. A method according to claim 1 or 2, characterised in that the core (60) is inserted into the mould cavity (54) and removed therefrom by means of a movable arm (58) to which it is attached.

4. A method according to any preceding claim, characterised in that the step of closing off the said gap (D) comprises the step of placing a secondary core (66) within the said gap (D) along the minor portion of the cut-out, placing the sealing strip (16) in a mould cavity such as to embrace the said gap (D) and the secondary core (66) therein and having an internal shape matching the external shape of the removed part of the sealing part (26), injecting material into this mould cavity so as to close off the gap (D), and removing the secondary core (66) through an aperture (74) in the sealing part (26).

5. A method according to any preceding claim, characterised in that the or each core (60,66) has a cross-sectional size and shape matching that of the respective portion of the removed material of the sealing part (26).

6. A method according to claim 4, characterised in that the secondary core (66) has a part (72) of narrowed cross-section to facilitate its egress through the aperture (74) in the sealing part (26).

7. A method according to claim 4 or 6, characterised by the step of closing off the aperture (74) in the sealing part (26) after removal of the secondary core (66).

8. A method according to claim 7, characterised in that the step of closing off the aperture (74) in the sealing part (26) comprises the step of inserting a grommet (80) into the aperture (74).

9. A method according to claim 8, characterised in that the step of inserting the grommet (80) into the aperture (74) by means of a piston (86) slidable

within a hollow cylinder (84), the piston (86) having a locking device (88) for mechanically interlocking it with the grommet (80), and by the step of supporting the material around the aperture (74) with the cylinder (84) while sliding the piston (86) away from the sealing part (26) so as to withdraw the locking device (88) from the grommet (80).

10. A method according to any preceding claim, characterised in that the hollow interior of the sealing part (26) is air-tight.

11. A method according to claim 10, characterised in that the sealing strip (7) comprises a channel-shaped gripping part (18) matching the length of and supporting the sealing part (26) and in that the sealing strip (7) is in the form of a closed ring produced by joining together the ends of a predetermined length of the sealing strip (7) such that part of the join (52) between the gripping parts (18) at the two ends is situated within the cut-out (50), and by the step of laying injected material over the said part of the join (52).

12. Apparatus for producing a bend of predetermined configuration in a hollow sealing part (26) of a longitudinally extending sealing strip (7), comprising a mould (60) having a mould cavity shaped and sized to receive the sealing strip (7) in a region where the sealing part (26) has been removed so as to form a cut-out (50) between first and second spaced ends of the sealing part (26), the mould cavity (54) having an internal shape matching the external shape of at least part of the removed sealing part (26), and a core (60), characterised in that the internal shape of the mould cavity matches the external shape of the removed sealing part (26) along a major part of the length of the cut-out but not including a minor part (D) thereof adjacent the said second end and is curved to match the curvature of the bend or corner, in that the core (60) is curved to match the curvature of the bend or corner, and by a device (58) for inserting the core (60) into the cavity (54), and a device for removing the core (60) from the cavity (54) after a moulding operation therein via the gap (D) in the sealing part (26) formed by the minor portion and which remains after the moulding operation.

13. Apparatus according to claim 12, characterised in that the device for placing the core (60) in position and the device for removing the core (60) comprises a pivotted arm (58) carrying the core (60).

14. Apparatus according to claim 12 or 13, characterised by a secondary core (66) adapted to be placed within the minor portion (D) of the cut-out, and a mould cavity having an internal shape matching the external shape of the removed sealing part along the minor portion of the cut-out (50) for receiving the region of the sealing strip (7) incorporating the minor portion and with the secondary core (66) therein.

15. Apparatus according to claim 14, characterised in that the secondary core (66) has a narrowed part (72) to facilitate its removal from the sealing part (26) via a hole (74) therethrough.

16. Apparatus according to claim 15, characterised by a device (82) for placing a grommet (80) sealingly within the said hole (74), the device (82) comprising a hollow rigid cylinder (84) around the outside of the periphery of the hole (74), and a piston (86) slidable within the cylinder (84) and having a device (88) for mechanically locking it to the grommet (80) and slidable for pushing the grommet (80) into locking engagement in the hole (72) and with the material of the sealing part (26) around the hole (72), whereby sliding of the pisto (80) in the opposite direction unlocks the locking device (88) from the grommet (80) as the material of the sealing part (26) is supported around the hole (74) by the cylinder (84).

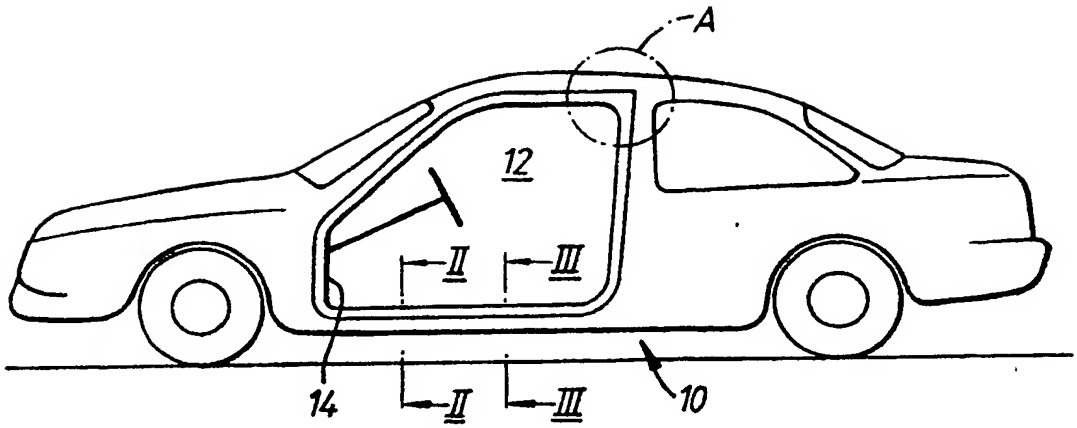

Fig.1.

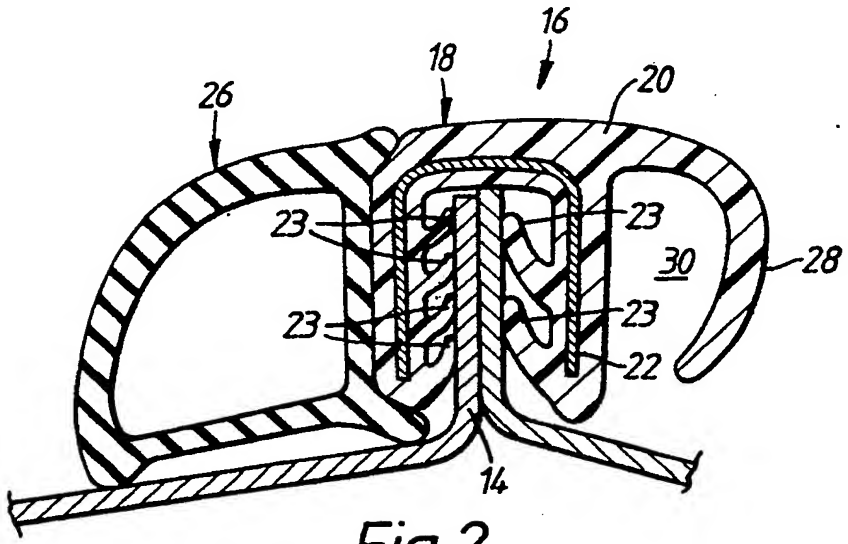

Fig.2.

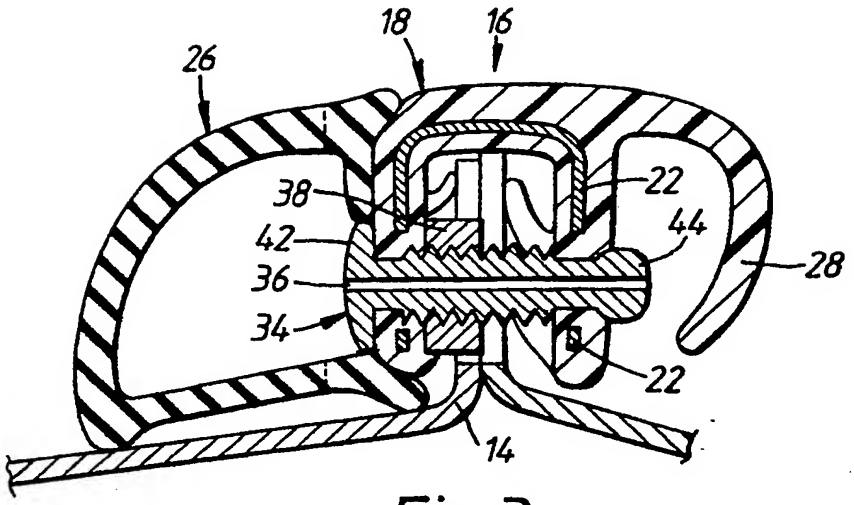

Fig.3.

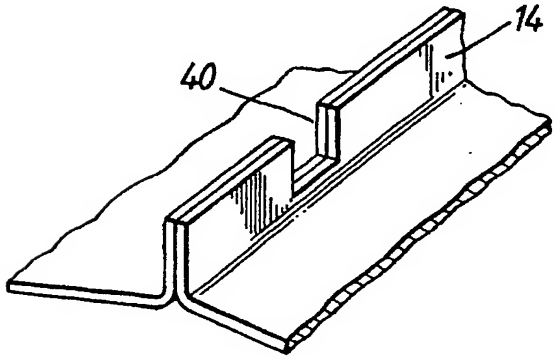

Fig.4.

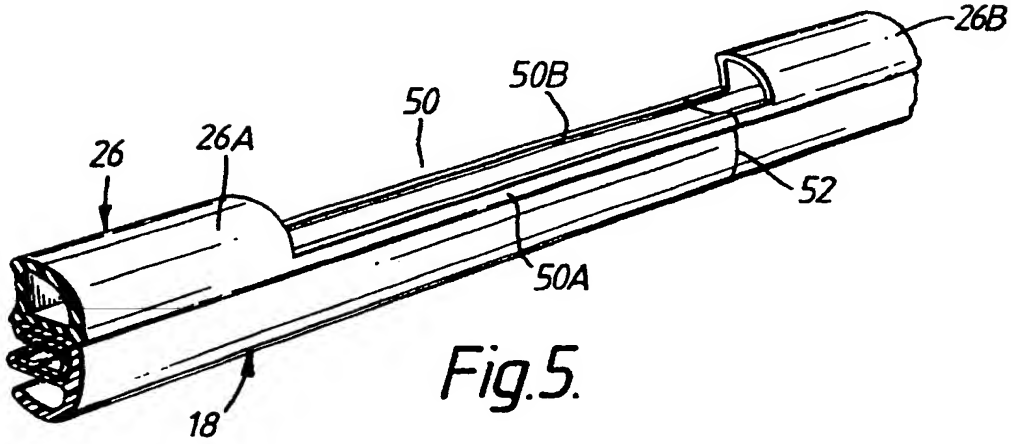

Fig.5.

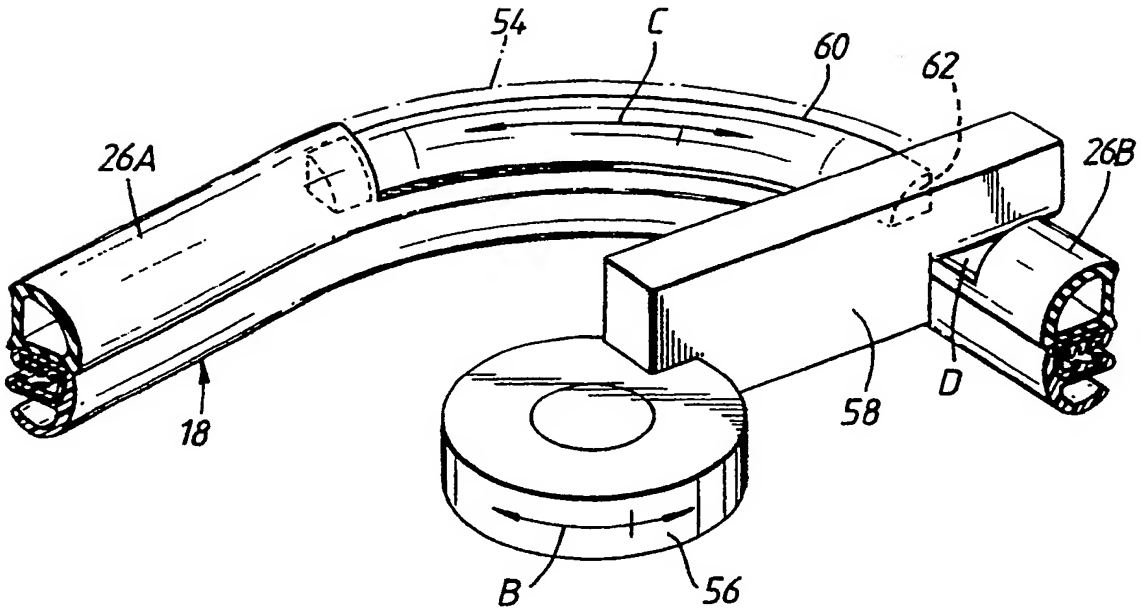

Fig.6.

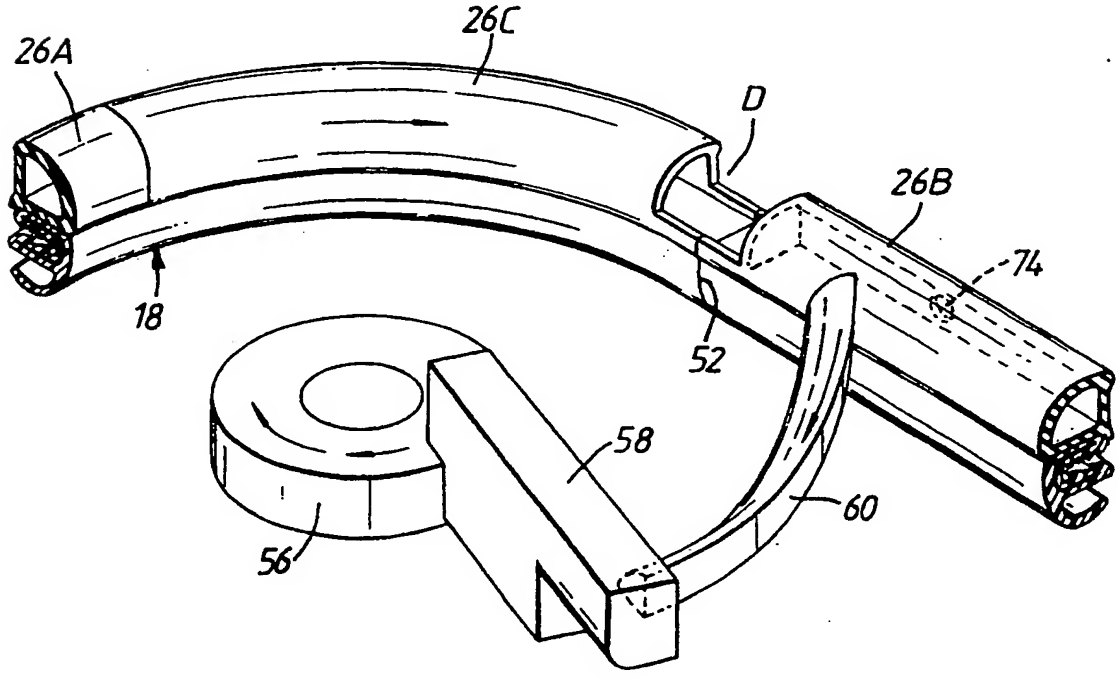

Fig.7.

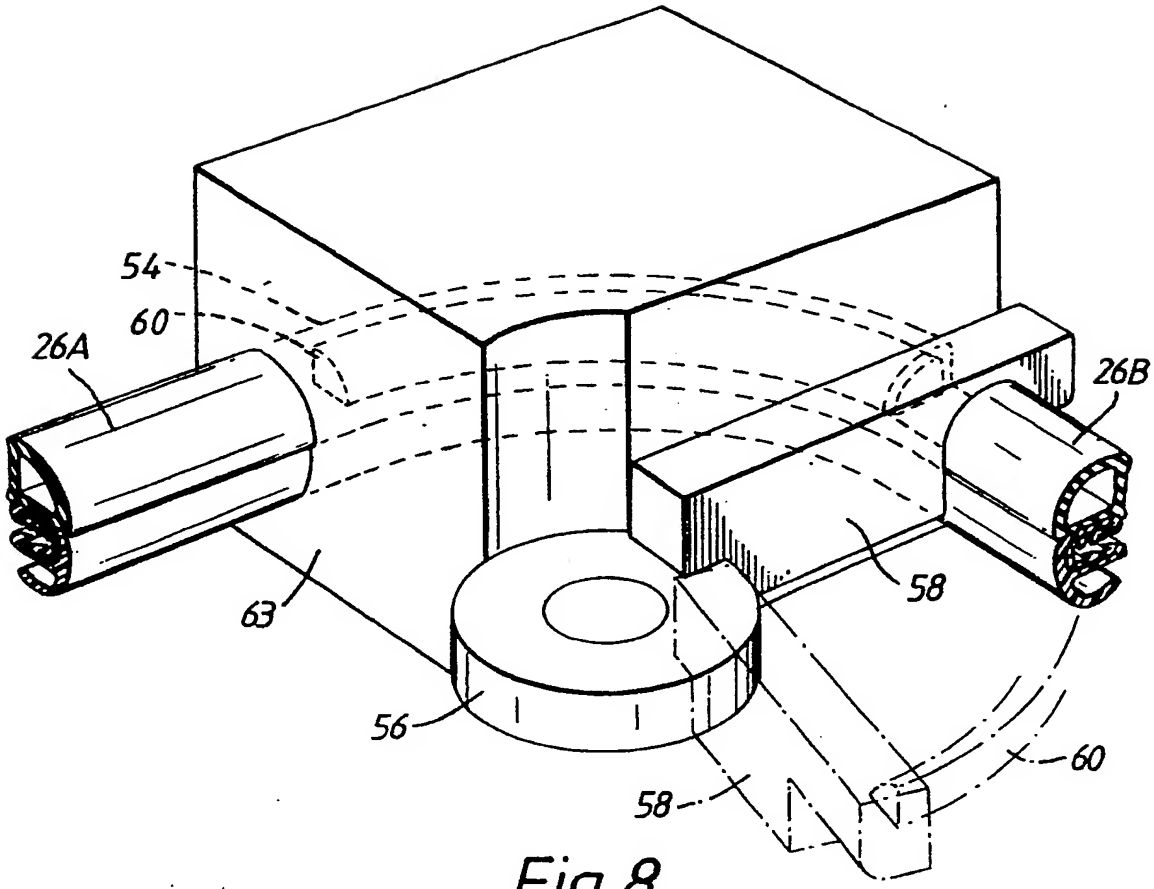

Fig.8.

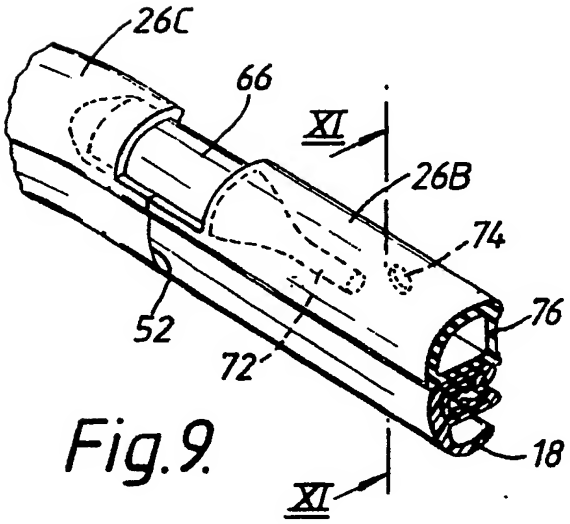

Fig.9.

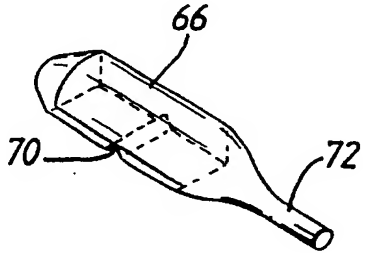

Fig.10.

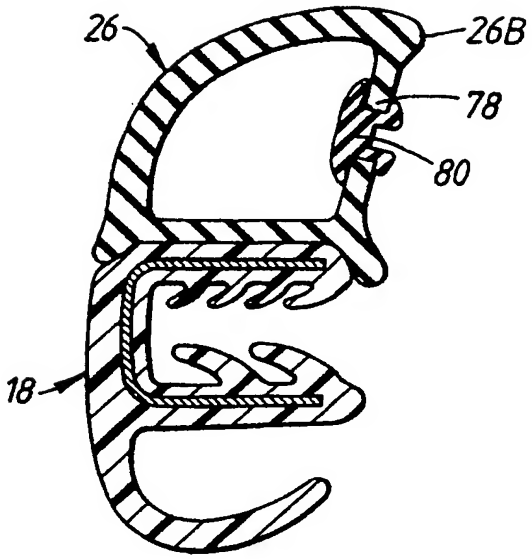

Fig.11.

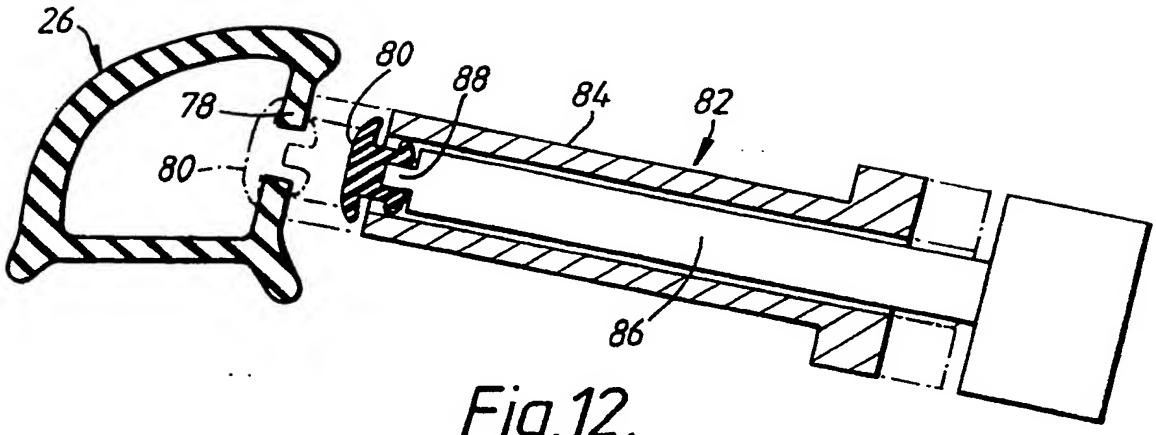

Fig.12.

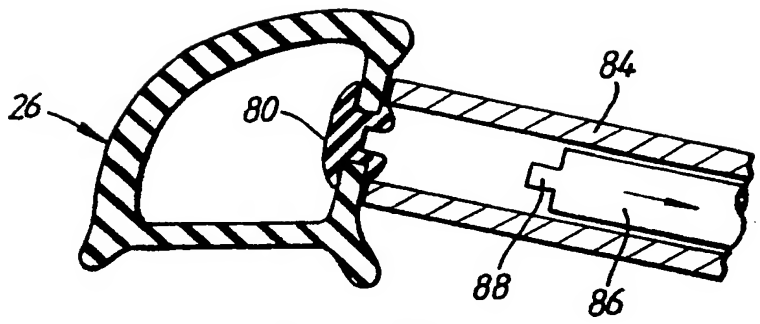

Fig.13.

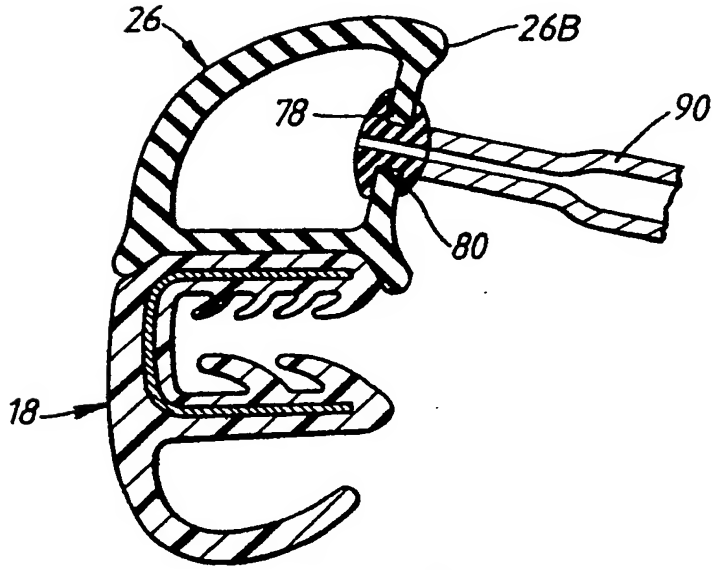

Fig.14.